Studio publicity still of Hedy Lamarr who became a leading Hollywood actress, playing roles that used her looks to great advantage, but she had an intellectual side that the public came to know much later. (Public Domain)

Overlooked Radio Heroine: The Life, Work and Inventions of Hedy Lamarr

By Georg Wiessala

Maybe you have not heard of Hedwig Eva Maria Kiesler (1914-2000). But I feel certain that you are all familiar with that gifted inventor's screen name, Hedy Lamarr. If not, you should definitely watch the film "Bombshell – The Hedy Lamarr Story."

Hedy was born in Austria, the daughter to Gertrud Lichtwitz, from Budapest, and Emil Kiesler, a banker from Lemberg (now: Lviv), She rose to stellar fame in the USA, as a film actress, and – more to the point here – as a multi-talented inventor. *The Guardian* brought it to the point in 2018, when it claimed, "Lamarr's story is one of a brilliant woman who was consistently underestimated." Quite.

Early Promise

Growing up in cultured, cosmopolitan Vienna of the early 20th Century, "What else, but theatre" – muses one of her biographers, Richard Rhodes –"and, by extension, motion pictures, would a bright, pretty, single-minded Viennese girl choose?"

Hedy enjoyed some early success in Vienna and in (what was then) Czechoslovakia. In the year Hitler came to power in Germany, she starred in the (then controversial) film Ecstasy (1933).

Controversial, because of its brief nudity and the first known faking of a female orgasm in cinema. Put that in your pipe and smoke it, Meg Ryan. Benito Mussolini, it is said, kept a copy of the film; Adolf Hitler, by contrast, banned it on antisemitic grounds. Both, however, had come to dinner at Hedy's, as did Gustav Mahler.

Lamarr left her first husband Fritz Mandl – an arms-dealer and Austro-fascist – to live as a Jewish émigré in Paris and London. She may have remembered many dinner table conversations over wartime technology.

She was eventually offered a Hollywood contract by MGM chief Louis B. Mayer.

A slew of 'exotic' adventure movies followed, among them Algiers (1938), Lady of the Tropics (1939), Boom Town (1940), H.M. Pulham, Esq. (1941), and White Cargo (1942). She was the Austrian Empress Elisabeth, and she rose to ultimate cinematic stardom in Cecil B. DeMille's Samson and Delilah (1949).

An A-list celebrity, Lamarr starred alongside Hollywood's top leading men. Here, she's with Clark Gable in a studio publicity still for the 1940 film, "Comrade X" (Public domain)

Unfortunately, she turned down the leads in both Gaslight (1940) and Casablanca (1942), both of which would, arguably, have cemented her standing in the minds of the American public even more.

Her final movie was The Female Animal (1958), and she also produced a couple of films herself; not, it has been said, too successfully. The mansion used in The Sound of Music (1965) belonged to her at the time.

Although she earned very large amounts of money during her career, she lost her fortune – along with her production company. She died, penurious, in Florida in 2000. Lamarr has a star on the Hollywood Walk of Fame at 6247 Hollywood Boulevard. There are many websites listing her films, the one here is but one example: **https://en.wikipedia.org/wiki/Hedy_Lamarr**

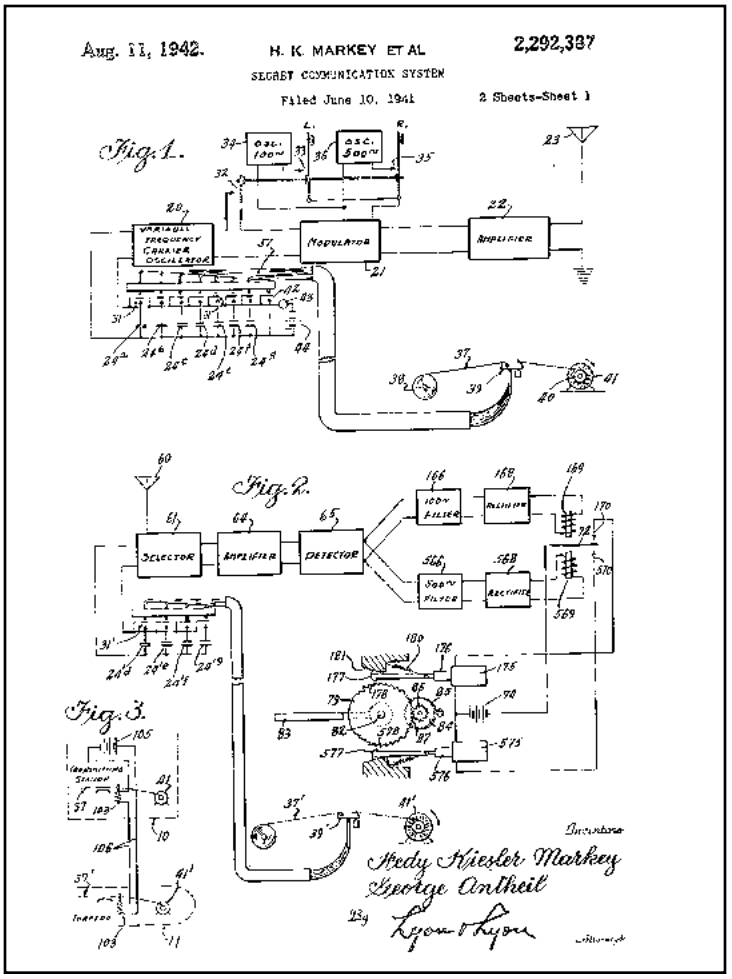
Frequency Hopping

As far as technology was concerned, Lamarr was self-taught. It is said that she often settled down to some inventing after a grueling day on a film set. Her hobbies and inventions were wide-ranging, including music boxes, traffic lights, more streamlined aeroplanes and effervescent cola tablets, to name but a few.

She was particularly fascinated by an early Philco 116RX ten-tube radio, by its remote control (the aptly-named 'Mystery-Control') and by mechanical player piano rolls.

She enjoyed significant support in these ambitions and activities, notably from aviation tycoon Howard Hughes (1905-1976) who provided her with a set of experimental equipment, and the composer and polymath George Antheil (1900-1959) – who used player pianos a lot in his work.

By the outbreak of World War Two, Lamarr found out that it was possible to deflect remotely-controlled missiles, such as torpedoes, by simply jamming the radio signal and altering the weapon's course.



US Patent details for Hedy Lamarr's 1941 "Secret Communications System." (Public domain)

In response to this, she proposed a method of secure radio communications: A frequency-hopping technique (*Frequenzsprungverfahren*), which would make jamming or tracking impossible.

Lamarr understood that, by transmitting radio signals along with rapidly-changing frequencies, US radio-guided weapons would be more resilient to detection and jamming.

Rhodes claims (2012: 147) that Hedy's idea – although original – might be derived from what she learned about the 18 frequencies of the German 'glide-bombs' of the period, mechanical player pianos and the Philco radio/ music box remote control. In the creative ferment of Hedy's imagination, these strands must have fused, sub-consciously, into her invention.

In her frequency-hopping system, the sequence of frequencies would be known by both the transmitter and receiver ahead of time; but to the German detectors, their message would seem like gibberish. No jammer could detect it, because no German code-breaker could decipher a completely random code.

With the help of George Antheil and others, Lamarr built a prototype for a machine, which coordinated a mechanical player piano with radio emissions. Two synchronized piano rolls were used to activate the transmitting radios, and the machine used the rolls to change between 88

UNITED STATES PATENT OFFICE

2,292,387

SECRET COMMUNICATION SYSTEM

Hedy Kiesler Markey, Los Angeles, and George Antheil, Manhattan Beach, Calif.

Application June 10, 1941, Serial No. 397,412

6 Claims. (Cl. 250—2)

This invention relates broadly to secret communication systems involving the use of carrier waves of different frequencies, and is especially useful in the remote control of dirigible craft, such as torpedoes.

An object of the invention is to provide a method of secret communication which is relatively simple and reliable in operation, but at the same time is difficult to discover or decipher.

Briefly, our system as adapted for radio control of a remote craft, employs a pair of synchronous records, one at the transmitting station and one at the receiving station, which change the tuning of the transmitting and receiving apparatus from time to time, so that without knowledge of the records an enemy would be unable to determine at what frequency a controlling impulse would be sent. Furthermore, we contemplate employing records of the type used for many years in player pianos, and which consist of long rolls of paper having perforations variously positioned in a plurality of longitudinal rows along the records. In a conventional player piano record there may be 88 rows of perforations, and in our system such a record would permit the use of 88 different carrier frequencies, from one to another of which both the transmitting and receiving station would be changed at intervals. Furthermore, records of the type described can be made of substantial length and may be driven slow or fast. This makes it possible for a pair of records, one at the transmitting station and one at the receiving station, to run for a length of time ample for the remote control of a device such as a torpedo.

The two records may be synchronized by driv-

Fig. 2 is a schematic diagram of the apparatus at a receiving station;

Fig. 3 is a schematic diagram illustrating a starting circuit for starting the motors at the transmitting and receiving stations simultaneously;

Fig. 4 is a plan view of a section of a record strip that may be employed;

Fig. 5 is a detail cross section through a record-responsive switching mechanism employed in the invention;

Fig. 6 is a sectional view at right angles to the view of Fig. 5 and taken substantially in the plane VI—VI of Fig. 5, but showing the record strip in a different longitudinal position; and

Fig. 7 is a diagram in plan illustrating how the course of a torpedo may be changed in accordance with the invention.

Referring first to Fig. 7, there is disclosed a mother ship 10 which at the beginning of operations occupies the position 10a and at the end of the operations occupies the position 10b. This mother ship discharges a torpedo 11 that travels successively along different paths 12, 13, 14, 15 and 16 to strike an enemy ship 17, which initially occupies the position 17a but which has moved into the position 17b at the time it is struck by the torpedo 11. According to its original course, the enemy ship 17 would have reached the position 17c, but it changed its course following the firing of the torpedo, in an attempt to evade the torpedo.

In accordance with the present invention, the torpedo 11 can be steered from the mother ship 10a and its course changed from time to time as necessary to cause it to strike its target. In

Left: Actress Hedy Lamarr from a publicity photo for the film 1944 film "The Heavenly Body." Right: Front page from her 1941 US patent for a "Secret Communication System." (Public domain)

frequencies. Art had truly met science.

Wartime Stimulus

According to the *Los Angeles Times* (2011), Lamarr's invention came about, because "she was keenly aware of the coming war. She was glued to the newspapers, reading all the stories. When German submarines began torpedoing passenger liners, she felt […] 'I've got to invent something that will put a stop to that.'"

As the war progressed, and her wartime fundraising activities gathered steam, Hedy approached the (then new) US National Inventors Council, stating, according to her biographer (Rhodes, 2012: 136), that "she knew a good deal about munitions and various secret weapons, some of which she had invented herself […]".

The National Inventor's Council had its roots in the sinking of the Cunard Liner Lusitania, on 7th May 1915, by a German submarine.

The ship sank, with the loss of 1,134 lives (Caldwell, S.: The Sinking of an Ocean Greyhound, *RadioUser*, January 2019: 63-65; Rhodes, 2012: 161/2). A few months later, in July 1915, Thomas Edison wrote to the *New York Times*, calling for ideas and practical suggestions, "either from the service or from civilian inventors" to be submitted to the Navy, in order to help with the war effort.

In a 1997 interview with fellow inventor Carmelo 'Nino' Amarena, Hedy revealed that, irrespective of the impetus of impending war, she had at first conceived of the general idea of a remotely-controlled torpedo.

She had then thought of radio waves, taking her inspiration from the first-ever wireless remote for a radio, which looked rather like an old-fashioned telephone dial.

Eventually, her (and George Antheil's) 'frequency-hopping machine' was granted a patent under US Patent 2,292,387 on August 11, 1942 (filed using her married name, 'Hedy Kiesler Markey').

Hedwig became a naturalized citizen of the United States at age 38 on April 10, 1953.

Delays and Successes

Notwithstanding such early activities, the US Navy was reticent at the time. The military took her idea and, as a recent documentary revealed, used it – eventually.

Meanwhile, Hedy Lamarr was advised that she would make a greater contribution to the war effort as a 'pin-up', in films such as White Cargo (1942), made to distract the troops, and by selling 'war-bonds', rather than as an inventor. And war bonds she did sell – to the value of US$343 million, in fact.

Consequently, ships were not equipped with Lamarr's invention until the time of the Cuban Missile Crisis (1962). By then, her system – previously rejected as 'too complicated' – spread like wildfire. Its most well-known application today are spread-spectrum communications, in particular, Bluetooth, as well as the development of new technologies for the prevention of the interception of telecommunications.

The patent, not just for a radio-controlled torpedo, but for a wider 'secret communication system' helped to solve the problem of enemies blocking signals from radio-controlled missiles during World War II. It involved changing radio frequencies simultaneously to prevent enemies from being able to detect the messages. While the technology of the time prevented the feasibility of the idea at first, the advent of the transistor and its later 'downsizing' made Hedy's idea important, both to the military and to the cell phone industry. It is estimated that the current market value of the technology is a staggering US$30 billion. **https://www.hedylamarr.com**

Out of the Limelight

She was married, and divorced, six times; famously, on one occasion, she sent her body-double to a divorce hearing. Her later life was marred by family problems, drugs, cosmetic operations gone wrong and legal troubles on various fronts.

In April 1998, for example, she sued the software company Corel Corp., for using her photo on the cover of its product CorelDRAW.

In spite of having been in the limelight for decades, Hedy Lamarr suffered increasing isolation, a fate she, arguably, shared with many other radio heroes, such as Nicola Tesla.

A documentary, "Calling Hedy Lamarr," was released in 2004. It featured her children, Anthony Loder and Denise Loder-DeLuca. It is hard to avoid the impression that the film played on her tendency to conduct almost all of her affairs over the telephone, later in life.

In 1997, Lamarr and Antheil received the Electronic Frontier Foundation Pioneer Award and the Bulbie Gnass Spirit of Achievement Award, and some very belated recognition for her work. This was followed, in 1998, by an Austrian award. An exhibition, Hommage à Hedy Lamarr, was organised in Austria in 1999.

Conclusion

Hedy Lamarr's life has inspired stage plays, books, novels, films and even a graphic novel. She never did have the opportunity to use her patent, and the legal protection afforded by it ran out in 1959. Consequently, she never did receive any money from it, in spite of writing to the US Navy about this in 1969.

Humiliatingly, before she became a US citizen, in 1942, her patent was even seized as "alien enemy property." The Navy, meanwhile, had used the frequency-hopping mechanism in ships and sonobuoys (a sonobuoy is a relatively small-buoy expendable sonar system that is dropped/ejected from aircraft or ships conducting anti-submarine warfare or underwater acoustic research). The great inventor's name also lives on in GPS systems, MILSATCOM military satellites and surveillance drones.

I have found no better quote on the amazing screen goddess and technological trailblazer that was Hedy Lamarr than the one used by Pamela Hutchinson, writing on women and representation in *The Guardian* in 2018: "If Lamarr's full story had been told while she was still working, or if she had ever played a woman as brilliant as herself in a film, perhaps the revelation that a star had brains, as well as beauty, wouldn't be quite such a, well, bombshell."

Further Reading and Resources

Cheslak, C. (2018) Hedy Lamarr: Bergan, R. (2000)

Obituary in *The Guardian* (2000)

The Guardian (1999) Hedy Mixture

Hutchinson, P. (2018) Hedy Lamarr – The 1940s 'Bombshell' Who Helped Invent Wi-Fi (*The Guardian*, 8th March 2018)

Lamarr, Hedy (1966). Ecstasy and Me: My Life as a Woman (New York: Bartholomew House)

Los Angeles Times: Hedy Lamarr: Inventor of More than the First Theatrical Film Orgasm (2011)

National Inventors Foundation (USA)

National Women's History Museum (USA):

Rhodes, R. (2012) Hedy's Folly – The Life and Breakthrough Inventions of Hedy Lamarr [….] (Vintage Books)

Shmavonian, Karl (2013, August 14). Thoughts On Innovation and Hedy Lamarr

Field, S. (2018): Hedy Lamarr: The Incredible Mind Behind Secure Wi-Fi, GPS And Bluetooth (*Forbes* magazine, 28th February 2018)

Film: Bombshell – The Hedy Lamarr Story

Podcast: Great Lives (Suzie Klein on Hedy Lamarr, BBC Radio 4)

Vienna Tourist Information

A previous version of this article appeared in a Radio Pioneers column of RadioUser magazine, May 2019. ***www.radioenthusiast.co.uk*** *—Editor*

TSM